



RESOURCE-EFFICIENT AND ENVIRONMENTALLY SOUND SOLUTIONS IN

Process Automation

In ABB's Process Automation Business Area, we are dedicated to equipping our customers in the process and maritime industries with products, systems and solutions that make their operations safer, smarter and more sustainable. Our offerings are based on ABB's leading technologies – such as distributed control systems, marine propulsion, turbocharging, measurement and analytics – as well as deep domain expertise and industry-specific products. Each solution is supported by a range of remote services for the duration of the asset's lifetime.

Reducing emissions through better marine technologies

Automation, electrification and digitalization are central to the energy transformation in the process and maritime industries. ABB plays a major part in reducing the environmental impact of the shipping industry with leading technologies that include Azipod® electric propulsion, the latest generation of turbochargers continuous emissions monitoring and the electrification of ferry services.

Azipod® is a gearless, steerable propulsion system that deploys an electric motor, placed in a submerged pod extending outside a ship's hull. Azipod® units rotate 360 degrees to increase maneuverability and operating efficiency, with a proven ability to cut fuel consumption by up to 20 percent compared to traditional shaftline propulsion systems. In addition to hardware, we provide fuel-saving software solutions to the marine industry. ABB Ability™ Tekomar XPERT diagnostic software enables large-vessel operators to reduce fuel consumption and manage their fleets more efficiently, collecting data from a wide range of sensors and other indicators in and around a ship's engines and recommending optimal settings for engine operation.



CASE STUDY

Technologies for cutting shipping emissions by 50 percent by 2050



Meeting the International Maritime Organization's goal of halving greenhouse gas emissions from ships by 2050 represents a critical step toward sustainability. ABB continued to work hard in 2020 to help the shipping industry meet it, providing a number of currently available technologies that can reduce fuel consumption and lower emissions, such as hybrid and electric vessel systems.

Our technology will be at the heart of P&O Ferries' sustainability program, as it transitions to the zero-emission future envisaged for shipping. Our contribution consists of supplying Guangzhou Shipyard International Ltd with a full scope of integrated solutions for P&O Ferries' two new vessels. The hybrid propulsion solution we are providing will use electric power from 8.8MWh batteries and diesel generators, cutting fuel consumption on P&O Ferries' Dover-Calais route by 40 percent. Equipped with four Azipod® propulsion units per vessel, each rated at 7.5MW, the 230-meter-long vessels will be the largest passenger and freight ferries ever to operate on this route when they enter service in 2023. In addition to Azipod® propulsion and energy storage, the new ships will feature a comprehensive scope of ABB solutions to cover power and propulsion, automation and power management.

We are also partnering with the American shipbuilding company Vigor Fab LLC as the hybrid-electric propulsion and energy storage system provider for the newest additions to the fleet of Washington State Ferries, setting the largest U.S. ferry system on course to zero-emission operations. The new "Olympic Class" ferries, which will have the capacity to carry 144 cars and 1,500 passengers each, herald a new era for the state of Washington as it seeks to shift toward technologies that enable significant reductions in GHG emissions and fuel use.

Upon delivery in 2024, the initial vessel of the class will be the first new build in Washington State Ferries' fleet to feature hybrid-electric propulsion and a high-capacity energy storage system. The new vessels will be able to operate fully on battery power and have the capability to revert to hybrid mode, if required. This landmark project supports the state's goal for 2050 to reduce emissions by 57.5 percent from a 2019 baseline.



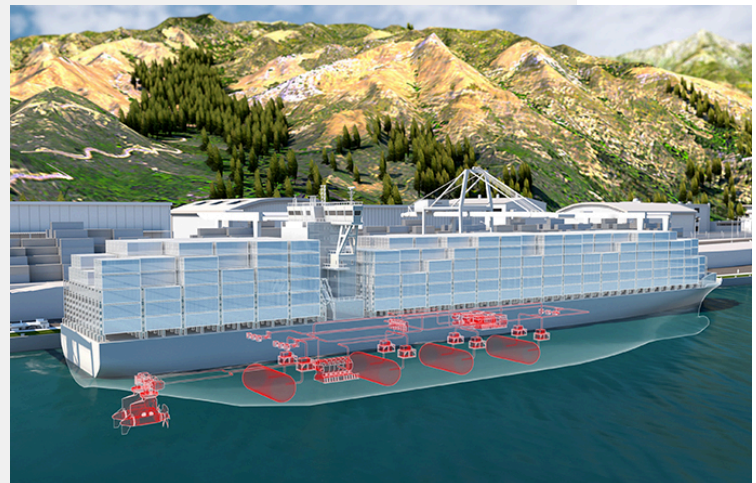
In January 2020, emission limits in International Maritime Organization (IMO) regulations became effective worldwide. To help customers comply, ABB expanded its extensive continuous emission monitoring portfolio with a marine-specific system called CEMcaptain. Our intention is that its measurement and digital capabilities increase on-board safety, provide process optimization, and substantially reduce ownership costs by requiring less maintenance.

We also offer zero-emission technology to the marine industry, and recently equipped a new generation of fully electric ferries that replaced the diesel vessels on the iconic Maid of the Mist tour at Niagara Falls. The two new 28-meter catamaran ferries are powered solely by high-capacity battery packs, making them the first fully electric vessels ever built in the United States.

Our solutions are also used in large, shaftline propulsion ships to increase engine efficiency. Our turbocharging portfolio comprises single- and two-stage turbocharging solutions. The latter is capable of producing high pressures at efficiencies of 75 percent or more, reducing fuel consumption, extending service intervals, and helping customers reduce environmental impact and comply with IMO regulations.

CASE STUDY

ABB brings fuel cell technology closer to powering large ships



With the ever-increasing demand for solutions that enable sustainable, responsible shipping, ABB's Marine & Ports division has made an important step towards powering oceangoing vessels with fuel cell technology.

In 2020, we signed a memorandum of understanding with hydrogen technologies specialist Hydrogène de France (HDF) to closely collaborate on the assembly and production of a fuel cell power plant for marine applications. This builds on an existing collaboration announced in 2018 with Ballard Power Systems, the leading global provider of proton exchange membrane fuel cell solutions. Our goal is to optimize fuel cell manufacturing capabilities to produce a megawatt-scale power plant for marine vessels. The new system will be based on the megawatt-scale fuel cell power plant jointly



developed by ABB and Ballard, and will be manufactured at HDF's new facility in Bordeaux, France.

With shipping responsible for about 2.5 percent of the world's total GHG emissions, there is increased pressure for the maritime industry to transition to more sustainable power sources. The International Maritime Organization, a United Nations agency responsible for regulating shipping, has set a global target to cut annual emissions by at least 50 percent by 2050 from 2008 levels.

Fuel cells turn chemical energy from hydrogen into electricity through an electrochemical reaction. By using renewables to produce the hydrogen, it is possible to create an entire energy chain based on clean technologies. ABB is proud to be working with HDF on a solution that could enable the global shipping industry to meet the emissions reduction target set by the International Maritime Organization (IMO).

Improving environmental performance with smarter industrial processes

ABB's automated control solutions are designed to increase output while reducing energy usage and waste of raw materials. Our suite of ABB Ability™ solutions and services uses sensors, network connectivity and data analytics to provide a real-time view into operations, enabling predictive maintenance, improved safety and better environmental performance.

This includes our first cloud application for original equipment manufacturers (OEMs), the ABB Ability™ Asset Performance Monitor. Launched in 2020, it collects data on production rates, energy consumption and temperature, and provides a continuous overview of an OEM's entire installed base, enabling more informed business decisions. Data is displayed on a digital dashboard, giving OEMs the necessary insights to initiate machine upgrades and advanced services. State-of-the-art security standards and transfer protocols ensure data integrity. This is just one of the many flexible, scalable and secure solutions that we offer to facilitate the shift to smart industrial processes. Digitalizing production processes increases system reliability and throughput, reduces raw material and energy use, and improves product quality.

With these goals in mind, ABB Process Automation has been deeply involved in laying the groundwork for an all-electric mine concept, developing several solutions focused specifically on the electrification, automation and digitalization of mines. One example is the ABB Ability™ Ventilation Optimizer, a modular system that maximizes the efficiency of mining ventilation systems. While maintaining proper air quality in a mine, this solution delivers energy savings of up to 50 percent per year.



CASE STUDY

Pilot project for the electrification of mining transport in Sweden



ABB has designed, delivered and commissioned electrical infrastructure capable of powering several electric mine trucks at Boliden AB's Aitik mine, Sweden's largest open-pit copper mine. The lane is ~700 meters and is expected to save ~830 m³ diesel per year. This infrastructure will ultimately enable Boliden to carry up to 70 million tons of rock every year at the mine, and reduce its greenhouse gas emissions from transportation by up to 80 per cent along those routes where the technology can be implemented.

Given that demand for copper is expected to continue to rise, driven by increased production of electric vehicles and the widespread use of renewable energy, ABB's electrification project at Aitik is a significant milestone. By enabling Boliden to increase productivity and safety at the site, we are helping the mining company to meet the high demand for copper in a sustainable manner.

To execute this project, we provided a digital substation, including a 4.8MW rectifier, connected to the ABB Ability™ System 800xA control system. This solution is our first-ever application for heavy-duty trucks in the mining industry. Our rectifier will efficiently convert alternating current to direct current, ensuring maximum availability and productivity. The substation will incorporate digital communications utilizing fiber optic cables to replace traditional copper cables, significantly reducing costs. It will also ensure safety, as systems are monitored digitally without requiring manual intervention.

The project is based on the ABB Ability™ MineOptimize offering, which provides mine operators with a suite of digitally connected solutions, products and collaborative services. The MineOptimize connected solutions at Aitik will send early alerts when the equipment needs servicing, provide remote assistance with real-time guidance, and offer remote monitoring to ensure optimal performance. The project is supported by the Swedish Energy Agency and is being executed by a number of collaborating parties.

ABB has been deeply involved in laying the groundwork for an all-electric mine concept and provides numerous solutions involving electrification, automation and digitalization – three key elements that are transforming the mining sector. Boliden is already partnering with ABB to develop automated solutions that can keep mine production running around the clock while improving safety. Building on our 90-year relationship, we have worked



together to achieve unprecedented levels of automation and control, both below and above ground, to optimize mine performance.

Driving the energy transition

ABB Process Automation is developing technologies to facilitate the energy transition for our industrial customers. As a member of the European Clean Hydrogen Alliance, ABB is helping to scale up the hydrogen value chain across Europe. Hydrogen has several uses, from storing renewable energy to fueling heavy transport, and as a feedstock in energy-intensive processes. Most importantly, hydrogen only emits water and heat when used as a fuel, releasing no carbon. In fact, if hydrogen is produced from renewable sources, the whole hydrogen value chain is carbon-free. Hydrogen thereby serves as an excellent complement to electricity and offers a solution to decarbonizing industrial processes and economic sectors where reducing carbon emissions is both urgent and difficult to achieve. Hydrogen is crucial to achieving the objectives of the European Green Deal and ensuring Europe's transition to clean energy.

To help hasten the energy transition, we are working with Hydrogen Optimized on the development of large-scale, environmentally friendly hydrogen production systems. In 2020, the two companies signed an MOU to make green hydrogen a financially viable option for our customers. We have also been cooperating with ABB's Electrification Business Area on the transformation of ABB's Busch-Jaeger production site in Lüdenscheid, Germany, into an example of how the energy transition can be successfully accomplished with currently available technology. We are exploring the possibility of using hydrogen as a clean source of energy at the site, which already has a solar plant that generates enough power on sunny days to meet all of its power requirements.

In the Asia-Pacific region, ABB is supporting the Hydrogen Energy Supply Chain (HESC) project. HESC aims to safely and efficiently produce hydrogen in Australia and transport it to Japan, in one of the world's first efforts to commercialize hydrogen liquefaction and transportation. The project is poised to position Australia as a leader in hydrogen production, and with the world's fifth-largest energy consumption, yet low fossil fuel resources, Japan considers hydrogen key to meeting future energy requirements. ABB won orders in both countries: an electrification and instrumentation contract in Australia, and an automation contract in Japan from Kawasaki Heavy Industries.



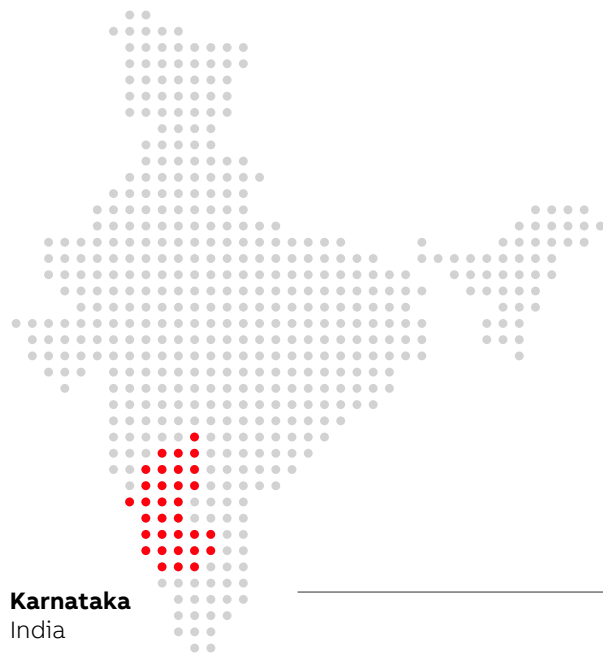
Conserving resources through advanced digital solutions

ABB Process Automation is a key provider of technologies and solutions that help conserve valuable resources such as clean water and natural gas.

We designed our ABB Ability™ Symphony® Plus SCADA to maximize the reliability and availability of water plants and networks. The control solution deploys integrated information management, the integration of equipment, and process optimization based on data from an entire water network. ABB's AquaMaster 4 electromagnetic flowmeters, which can run on battery power, provide reliability even in low flow conditions and in areas where most mechanical flowmeters would fail. ABB flowmeters are used across India in urban, semi-urban and rural settings. For example, in the Koppal district, a drought-prone region in southwestern India, we provided end-to-end digital water management solutions to help the local water authority not only track, measure and optimize water use, but also pump and distribute treated river water to homes. Equipped with ABB Ability™ Symphony® Plus SCADA and ABB's AquaMaster 4 flowmeters, the district is effectively monitoring water flow, managing leaks and delivering overall productivity improvements to its widely dispersed network.



ABB supports India's Koppal district to ease water shortages with digital water management solutions



600,000
of Kushtagi and Yelbargi Taluka villages currently rely on local wells and face regular water shortages.

620 tanks & 16 reservoirs
will bring clean treated river water to their homes in a new end-to-end solution.

ABB Ability™
Symphony Plus SCADA
will analyze flow and consumption by sharing real-time data with a central control room.

AquaMaster 4
electromagnetic flowmeters will track how much water is passing through the network.

We also offer solutions to rapidly detect and locate gas leaks, which is not only critical to the security and resilience of gas infrastructure, but also to reducing GHG emissions. Our complete Gas Leak Detection Platform makes it possible to find leaks in any natural gas infrastructure – upstream, midstream, downstream or utilities – with far higher reliability and speed than ever before by combining sophisticated measurement technologies with advanced data analytics. The innovative platform uses advanced laser absorption technology to provide fast, sensitive measurements that distinguish between naturally released methane and gases leaking from a buried pipe or other potentially dangerous source.



CASE STUDY

Guarding gas lines to make clean energy sources safe



Leaking natural gas pipelines are health and environmental hazards which, if undetected, can result in wasted resources, unwanted emissions, and even personal and ecological harm. Governments around the world are improving gas leak detection abilities to ensure public safety, conserve energy and reduce environmental impact. ABB gas leak detection technology can help.

The new portable ABB MicroGuard™ detection device enables surveyors to quickly find leaks on foot, and can be used stand-alone or with ABB's MobileGuard™ vehicle-based detection system, to precisely identify leak locations.

These offerings employ laser absorption for fast, highly sensitive measurements that identify gases leaking from a buried pipe or other source. The technology continuously measures emissions, wind velocity and local coordinates to pinpoint leaks. Software eliminates false positives, reducing search areas and guiding technicians to locations. Digital reports are generated in real time, helping crews to prioritize resources and repairs. Regulatory compliance is easier because data is digitally available, immediately.

A leading Asian oil company monitors its extensive pipeline network with MobileGuard, significantly expanding speed and range of detection, and reducing safety risks and environmental impact, all while conserving gas and cutting monitoring costs. These benefits helped the customer achieve important business objectives in a difficult year. Similarly, more than 30 cities in China use MobileGuard to monitor pipelines to improve health and safety.

This technology can be used on aircraft and drones (ABB HoverGuard™), to survey locations inaccessible on ground, as well as on fixed locations (ABB EverGuard™) to continuously monitor high-risk areas in well pads, gathering lines, pipelines, factories, distribution stations and storage facilities.

ABB gas leak detection helps find leaks upstream, midstream and downstream. These technologies help utilities and service providers to improve safety, conserve energy and reduce environmental impact. They are important components in a comprehensive industrial or municipal sustainability strategy.



In Western Australia, our gas measurement technologies will soon also be used to help convert waste into sustainable energy. In 2020, three ABB ACF5000 analyzers were selected to monitor, measure and analyze the composition of exhaust gases at the new, large-scale East Rockingham Waste-to-Energy facility near Perth. ABB Ability™ Condition Monitoring for measurement devices will enable us to monitor these analyzers remotely throughout their lifecycle.

Lessons learned

Over the past decade, the oil & gas, mining and marine sectors have dramatically changed, and our business has adapted to serve their needs. Increasingly, our customers are turning to ABB to help them save energy, increase safety, reduce costs and achieve their own, wider sustainability goals. Because our customers face increasing regulatory obligations across all of their markets, an investment in automation technologies that improves environmental performance is frequently viewed not only as the right thing to do, but also as a sound business decision that can drive overall safety, efficiency and productivity.

Based on our experiences during the previous sustainability reporting cycle, we have learned that we need to elevate the profile of our contributions to sustainability. While our customers have always known and recognized ABB for the safety and efficiency of our portfolio, we see an opportunity to emphasize how our solutions can contribute to reducing their environmental footprints. This will involve educating our salesforce, raising awareness of our contributions among all of our employees, and building a stronger understanding of our offering in the market.